Consumer valuations of energy efficiency investments: The case of Vietnam's Air Conditioner market

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ABSTRACT

Research on the energy-efficiency gap in developing countries remains very scant. In this study, we apply the hedonic price model to investigate how Vietnamese consumers value the energy efficiency of air conditioners (ACs). We assume that the energy efficiency of ACs in the Vietnamese market improves to that of ACs in the Japanese market. Then, we calculate the payback period by dividing the capital cost to improve the energy efficiency by the annual electricity cost saving. We show that the initial investment cost can be recovered in a short time. In addition, we calculate the implicit discount rate to show how Vietnamese consumers value energy efficiency investment. We find that the implicit discount rate in Vietnam's AC market is much higher than the rates found in studies on developed countries. Hence, consumers in developing countries place much lower value on energy efficiency investment than consumers in developing countries, even though purchasing energy-efficient appliances offers opportunities to save substantial amounts.

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1. Introduction

According to the United States Energy Information Administration (2014), energy use in non-OECD countries is forecast to grow by 2.2% per year from 2010 to 2040. Simultaneously, energy use in OECD countries is projected to grow by only 0.5% a year in this timeframe. As a result of their higher growth rate, non-OECD countries' proportion of total global energy use is expected to exceed 65% in 2040.

Although OECD countries still emit far more CO2 than most other regions on a per capita basis (OECD, 2012), there are significant increases in per capita emissions from rapidly growing non-OECD economies. For instance, per capita CO2 emissions in China increased from 2.7 metric tons in 2000 to 6.2 metric tons in 2010 while emissions in Vietnam increased from 0.7 metric tons to 1.7 metric tons over the same timeframe (World Bank, 2014a). These statistics reveal the importance of energy savings in developing countries.

As incomes rise, households in developing countries begin purchasing home electric appliances. For example, in 2000, for every 100 urban Chinese households, there were 30.8 air conditioners (ACs), 49.1 water heaters, 9.7 computers, 17.6 microwave ovens, and 19.5 cellphones. By 2010, these numbers had risen to 112.07 ACs, 84.82 water heaters, 71.17 computers, 59 microwave ovens, and 188.86 cellphones (National Bureau of Statistics of China, 2013).

Farrell (1954) argued that an S-shaped relationship exists
between household income and asset ownership: the ownership ratio of energy-using assets remains low until per capita income reaches a certain “acquisition” threshold, but takes off very rapidly thereafter.

The World Bank (2008) examined the acquisition of refrigerators and ACs in India. It then estimated that the threshold for refrigerator ownership is just below an annual income of 10,000 USD per household, while that for an AC is just below 20,000 USD. Wolfram et al. (2012) analyzed the relationship between total annual expenditure per person in Mexico and the acquisition of refrigerators and cars, and then estimated that the threshold value for each of these durables was around 800 USD.

Increased ownership of energy-using durables will be a major driver of energy demand in developing countries. Therefore, many researchers have analyzed the diffusion process of appliances extensively. For instance, McNeil and Letschert (2005) examined the relationship between refrigerator ownership and household income in Brazil, Mexico, Nicaragua, Panama, Peru, and South Africa. Nevertheless, less attention has been paid to the energy efficiency of appliances sold in developing countries. Large variations exist in appliance energy efficiency around the world, and consequently, appliance energy consumption during use varies substantially. Simply knowing how many appliances will be sold does not provide sufficient information to forecast future energy demand in developing countries accurately. Information on appliance type must also be known.

The purpose of this study is to understand how consumers in developing countries value the energy efficiency of appliances. Specifically, we attempt to answer the following three questions by analyzing sales data of ACs in the Vietnamese market. Do people in developing countries value energy efficiency similarly to people in developed countries? Do people in developing countries purchase appliances with similar energy-efficiency ratings as those bought in developed countries? By how much can energy consumption and CO2 emissions be reduced through the promotion of energy-efficient appliances? To the best of our knowledge, this is the first study that provides empirical evidence to answer these questions based on statistical analysis of market data.

There are reasons to believe that people in developing countries form future expectations differently from people in developed countries. Meier and Whittier (1983) reported that valuations of energy efficiency vary across geographical regions within the United States (US). In addition, a country’s geographical conditions are likely to influence citizens’ future expectations. Developing countries are growing more rapidly than developed countries. Therefore, the optimal social discount rate given by the Ramsey formula (Weitzman, 2007) in developing countries is larger than that for developed countries. Differences in social discount rates affect future expectations. Hausman (1979) estimated the probabilistic choice model of ACs in the US and reported that low-income households value the benefit of energy investment less than high-income households. Lawrence (1991) found that subjective rates of time preference are 3–5 percentage points higher for households with low incomes than for those with high incomes. Liquidity constraints mean that households in developing countries cannot afford an energy-efficient appliance even if they know that such a purchase would be beneficial to them in the long run. Finally, people in developing countries often lack information about differences in future operating costs between more efficient and less efficient products that would enable them to make proper investment decisions (Howarth and Sanstad, 1995).

The rest of this paper is organized as follows. In Section 2, we conduct a brief literature survey of implicit discount rate and provide background information about Vietnam’s AC market. In Section 3, we explain our dataset, which contains data on ACs obtained from GfK Marketing Service. We employ a hedonic price model to show how Vietnamese consumers value energy efficiency in ACs. In Section 4, we specify our empirical model and report empirical findings. The empirical results demonstrate that Vietnamese consumers place a much lower value on energy efficiency investments than consumers in developing countries. Using the estimation results, we conduct several simulation analyses and calculate the benefit of energy saving in Section 5. We conclude the paper in Section 6.

2. Background

2.1. Literature survey

Typical consumers underestimate the benefits of future energy saving and underinvest in energy efficiency relative to the socially optimal level of energy efficiency. This phenomenon was named the “energy-efficiency gap” by Jaffe and Stavins (1994) and has been studied widely in many developed countries. The energy-efficiency gap is often illustrated by comparison with the market discount rate and the implicit discount rates that are implied by consumer choices concerning appliances with different costs and energy efficiencies (Hausman, 1979). Four types of empirical models have been used to measure implicit discount rates (Train, 1985; Dubin,
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